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Window review

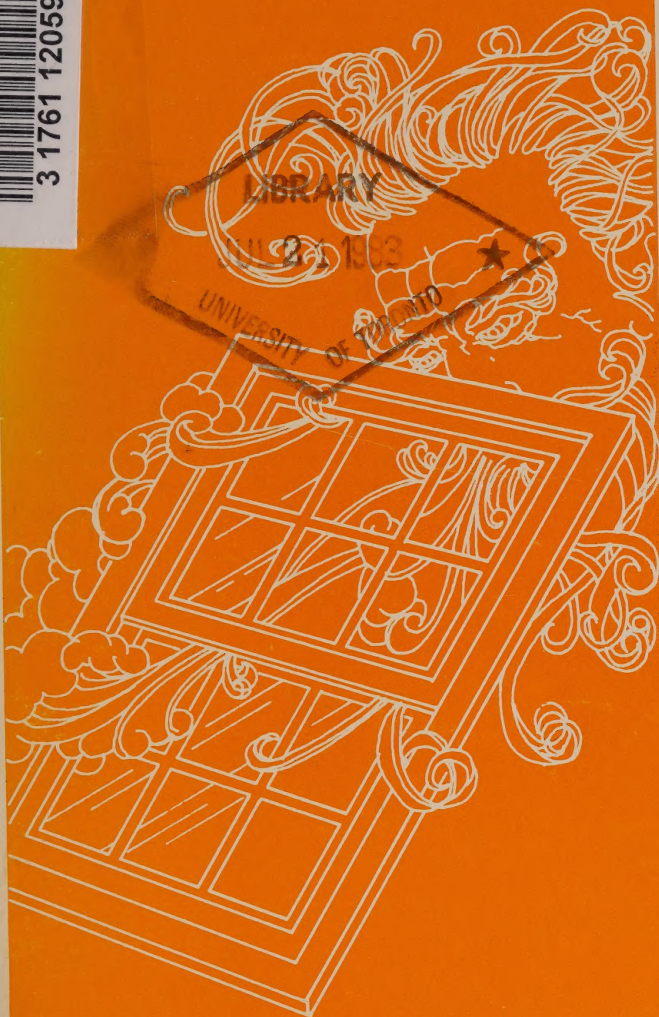


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Ontario

Ministry of
Municipal Affairs
and Housing

Hon. Claude F. Bennett
Minister



Energy
Ontario

Contents

	Page
Introduction	1
Windows — Both a Liability and an Asset	2
Features of a Good Window	4
Assessing Your Situation	5
Upgrading Existing Windows	6
Adding Glass	8
Adding Permanent Glass	9
New Windows	10
Movable Insulation	12
Solar Gains	14
Skylights	16
Solaria and Greenhouses	17
Getting the Job Done	18
Access	19

Renovation and Energy Conservation Unit
Ministry of Municipal Affairs and Housing
Queen's Park, Ontario
M7A 1N3

February 1983

Windows — Introduction

If your house is like most, your windows are probably responsible for 20 percent of your total fuel bill.

There are many different types of windows and each type can be improved in a variety of ways. This booklet will help you decide how to improve the windows in your house, from upgrading the ones you have now to installing new ones. We also describe night-time insulation and how to make the most of solar heating.

Many of these improvements, such as weather-stripping and caulking, you can do yourself. Others, such as installing new windows, are more difficult unless you are an experienced do-it-yourselfer. If you prefer to hire contractors, use this booklet to discuss the details with them.

Your first energy conservation priority for most homes should be to seal drafts and air leakage areas which occur around windows, doors and throughout the house. Then insulate the attic and basement, add extra glass to single paned windows and tune up your furnace. An efficient house requires attention to all its components. Other booklets and fact sheets in this series, listed at the back, will help you achieve an energy conserving house.

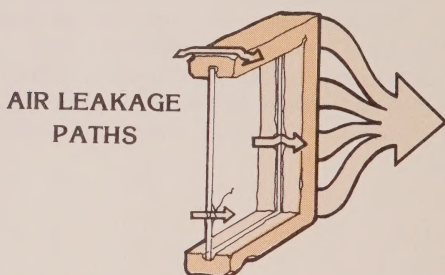
Windows — Both A Liability and An Asset

When windows are properly designed and located, they can reduce your electrical bill by virtue of the natural lighting and reduce your fuel bill by providing for solar heat in winter. By strategically locating windows that open throughout the house, your house will also be much cooler in summer.

Yet for all their benefits, windows can be expensive and uncomfortable. There are frequently cold drafts and cold corners in homes with older, inefficient windows.

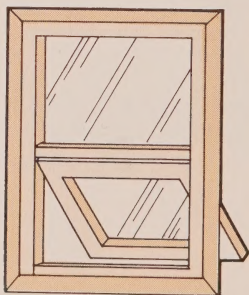
Windows — Sealing Against Leaks

Cold winter air flows into the house through the leaks and cracks around the window frame and glass and through the operating joints of the sash (the wood or metal sections which hold the glass). As cold air enters the house, heated air escapes through other leaks in the structure, increasing your fuel bill. Caulking and weatherstripping should be done on the *inside* to reduce uncontrolled air leakage.



Windows — As Ventilators

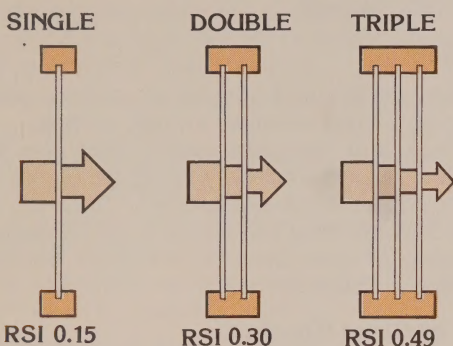
Sealed windows are the most efficient in winter. However, it is important to have opening windows to provide summer ventilation. Opening windows and screen doors should be located to allow the prevailing summer winds to blow through the house and to allow stuffy air to escape from the top floors. Once you have established which windows are used for ventilation, the others can be caulked shut.



Windows — As Insulators

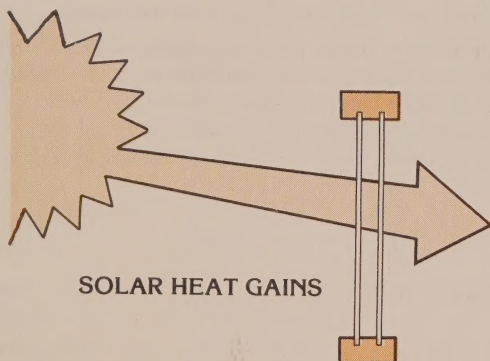
A single layer of glass has very little insulating value because glass provides minimal resistance to heat loss. Most of the insulating value is provided by the layer of air on either side of the glass. By placing a second pane of glass beside the original — known as double-glazing — a layer of air is trapped between the panes.

Double-glazing will reduce heat loss by about 50 per cent over single glazing. The addition of another pane of glass — triple-glazing — results in a total heat loss reduction of about 65 per cent.



Windows — As Heaters

If windows face south, they can provide a large portion of home heating requirements by using heat from the sun. During a typical winter, the solar equivalent of about 68 litres (15 gallons) of heating oil can enter an average south-facing, double-glazed window in Toronto. However, an excess of south-facing glass can lead to overheating problems even during the winter months. Provision must be made to prevent or control overheating.



Features of A Good Window

A good window has an insulating value and doesn't leak air. The factors affecting the quality of a window are its frame, operation and the number of glazings.

Frame

A wood-frame window generally is more efficient than a metal-frame window since aluminum and steel conduct heat several thousand times more quickly than wood. Metal frames should be manufactured with a "thermal break". Material, such as rubber or wood, is inserted in the frame between the inside and outside surface to prevent the cold from passing through.

Operation

There are two types of opening windows — sliding and hinged. Sliding windows include vertical double-hung and horizontal sliders. They tend to be very leaky. Hinged windows include casement and awning windows which swing open. These are more efficient because they can be more tightly sealed. Fixed panes of glass have the lowest air leakage rates when installed correctly.

Layers of Glass (Glazing)

If you have one pane of glass, you should add at least one more pane. In colder parts of the province or in areas where comfort is particularly important you should install triple-glazing. Since manufacturers' prices can vary widely, it pays to shop around.

Although sealed units of double or triple glazing generally are the most effective and trouble-free, you can install interior or exterior storms as a good alternative. The spacing between the glass is important. A 12mm ($\frac{1}{2}$ inch) gap should be the smallest and 100mm (4 inches) the widest. Any narrower or wider and heat loss increases.

When there is more than one pane of glass, except for factory sealed units, the inside glass should be more air-tight than the outer pane(s). This will reduce condensation since any moist air that gets past the inside pane of glass can escape to the outside.

Assessing Your Situation

Whether you are doing a small job or a major renovation, you have an opportunity to improve your windows.

The windows in your house may require different kinds of work; some may have to be replaced or enlarged; others may need only weatherstripping and caulking; and others, such as fixed double or triple-glazed windows, may be fine the way they are.

Most windows require weatherstripping and caulking to reduce drafts. This may be all you need when:

- Your windows are in good shape (and at least double-glazed).
- Maintaining the aesthetics of a window is important. For example, you may not want to replace a stained glass window.

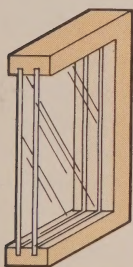
Consider installing additional layers of glass to an existing window if:

- Your windows are only single-glazed or your storms are beyond repair.
- The frame and sash of the windows are in good repair and worth saving.

In some cases, the existing windows are difficult to repair. Consider replacing them if:

- The sill, sash or frame is rotted.
- The window is warped or damaged and air leakage is difficult to control.

Finally, there are design opportunities if you are adding siding or remodelling the walls of your house. Under these circumstances you can reduce or eliminate windows in non south-facing locations — especially in rooms which are not used a great deal. You can also add or enlarge windows to maximize light and heat in rooms with a southern exposure.



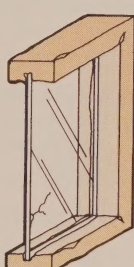
**DOUBLE PANE
GOOD SHAPE**

page 6 & 7



**SINGLE PANE
GOOD SHAPE**

page 8 & 9



BAD SHAPE

page 10 & 11

Upgrading Existing Windows

Improving the performance of your windows involves improving the seal, durability of the unit and increasing the number of panes.

Improving the Seal

Most older windows were built and installed with little attention to air leakage. Cold air can leak into the house between the window frame (known as the jamb) and the rough house frame which come together behind the trim. Air leakage can also occur through any loose fitting movable joints of a window. And finally, air can leak around the edges of the glass where putty has failed.

Around The Window Frame

- If drafts are minor, lay a bead of clear silicone or paintable acrylic latex caulk around the edges of the window trim.



- For better results, remove the interior window trim and inject polyurethane foam (available in aerosol cans) in the gap between the window jamb and the house frame.
- If you are renovating walls and installing a new vapour barrier, caulk and seal the plastic directly to the window jambs to prevent air leakage.

Each window type will require a different sealing technique. Weatherstrip operable joints of windows that open. Adjust the closing mechanism so that the window shuts tightly against the weatherstripping when it is closed. Finally, for those windows you've decided not to use for ventilation, seal the joints with a bead of silicone or acrylic latex caulk.

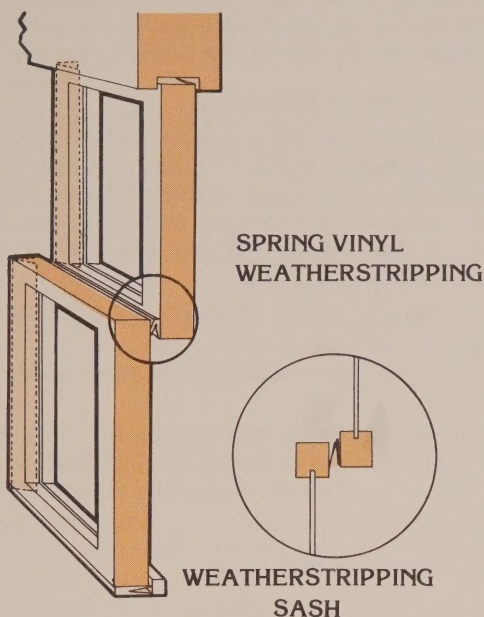
The general approach to different types of windows is sketched out below. Detailed instructions are contained in the ministry's fact sheet on *Caulking and Weatherstripping*.

Improving Windows From The Exterior

If you have water-stains around the windows inspect the flashing above the window and replace it if necessary. If the wood is beginning to deteriorate, scrape the window of old paint, reseal and repaint or stain it. Install new putty and glazing points (if required) around the edges of the glass to ensure proper drainage away from the window.

Double-Hung Windows

A spring vinyl weatherstripping provides a good seal. To install it you have to remove the stop and lift out the window. The point of the V should face inside the house, as illustrated.



Sliders and Patio Doors

Fix one pane in place with silicone caulk. Install spring vinyl weatherstripping around the movable edges of the sliding pane of glass.

Aluminum, steel and vinyl sliders generally come with built-in weatherstripping that you should replace when it wears out. Pry out a sample and purchase a replacement from the window manufacturer or distributor.

Casement and Awning Windows

Weatherstrip around the stop of the window with spring vinyl or foam type weatherstripping. Ensure that the closing mechanism is functioning properly to maintain a tight seal. Make sure that the window still closes properly.

Fixed Glass

You can improve the seal by caulking fixed panes of glass with silicone. If the glass is loose, you can re-install the window onto a layer of glazing tape (a roll of caulking) or use glazing points and putty or a glazing compound.

Adding Glass or Plastic

As a cheaper alternative to replacing your windows, you can add glazing if the wood frame and sash are in good repair and can be well weatherstripped. You can add glass or plastic as either interior or exterior storm windows, or you can mount it permanently on the existing sash or window frame. Storm windows are usually easier to install.

Exterior Storm Windows

You can install wood or aluminum frame storm windows to the exterior of a house during the heating season or as permanent fixtures. Aluminum storm windows are cheaper and are more common, although they are less efficient than their wood counterparts.

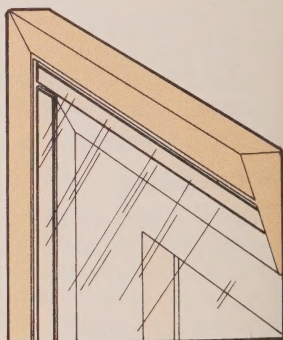
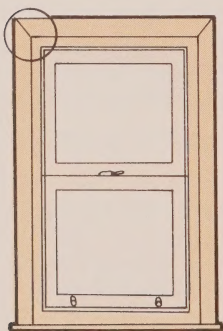
When installing storm windows, consider the following points:

- The inside window should be more air-tight than the storm addition.
- The storm should be located from 12 to 100mm ($1\frac{1}{2}$ to 4 inches) from the existing window. This reduces heat losses caused by air circulation in the space.

Interior Storm Windows

Interior storms are available as a do-it-yourself package or as commercially produced and installed units. They are generally made from plastics that are lightweight and easy to handle. One new product involves taping a thin plastic film over the window and then heat shrinking it until it is taut.

Interior storms should be more air-tight than the existing glass to reduce condensation problems. Some units come with snap edge seals or magnetic tape for easy operation and removal during the summer. Leave a gap between 12 to 100mm ($1\frac{1}{2}$ to 4 inches) between new and existing glazings for maximum efficiency.



INTERIOR STORM WINDOW SEALED TO TRIM

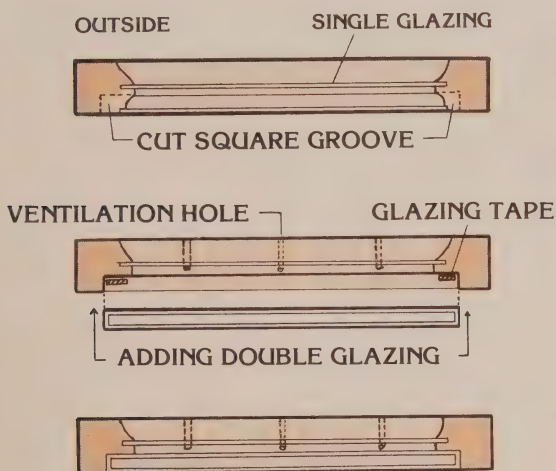
Adding Permanent Glass

You can install additional panes of glass directly over the wood frame of your existing fixed window to make a single-paned window into a double or triple paned unit. Or you can add the new glass directly onto the *sash* of an existing wooden unit. The latter technique has the advantage of maintaining the look of your windows while allowing them to open.

The window should be sturdy and preferably a sliding type since the added weight can make operation difficult. Lighter material than glass, such as plastic, will be more convenient if the window is used frequently.

This job requires expert do-it-yourself skills or a professional carpenter. Follow these steps:

- Remove the window and cut a squared-off groove, with a router or circular saw and chisel, in front of the existing glass. Take care not to break the glass!
- If cutting out the groove seems too difficult, add a moulding for the new glass right over the existing sash.
- Measure and order new glass to fit the opening, allowing for adequate clearance, usually 3mm ($\frac{1}{8}$ inch) on each side.
- Drill ventilation holes to the outside from the new air space to prevent condensation build-up. Two or three 2mm ($\frac{1}{16}$ inch) holes will do.
- Install the new glass using glazing tape or silicone.
- Cover the edge of the glass with new moulding.



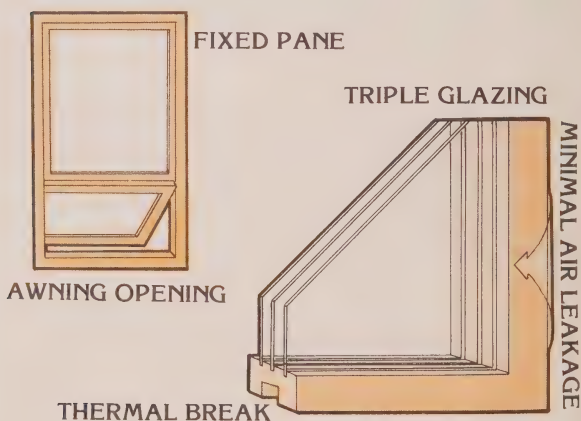
New Windows

When purchasing new windows, look beyond the price tag. Consider also the window air leakage characteristics listed by the manufacturer, the number of panes of glass and the type of operation. Here are some important factors to consider:

- Purchase windows with fixed panes of glass wherever possible because they are the least expensive. Where ventilation is required, awning or casement windows are the most efficient.
- If you live in a colder region of the province or you wish to keep the room especially comfortable, it's worthwhile to buy the more expensive triple-glazed windows. Prices for these windows will be up to 30 per cent more than double glazed units. Check the space between the glass. Try to buy units with at least 12mm ($\frac{1}{2}$ inch) gaps.
- Ensure that no direct heat flows from the outside to the inside; metal windows should have thermal breaks in the frames.

It is possible to purchase "replacement windows" which replace just the glass and sash. Although they can cost as much as a complete new window, they are easier to install. Make sure you remove the casing of the old window and fill the gap between the frame of the house and window jamb with polyurethane foam. Otherwise, your new window will leak air as badly as the old one.

If you are installing new windows, take the opportunity to re-evaluate their size and location. Consider installing smaller windows or decreasing the size of the windows on the north side of your house and increasing the size of those on the south side. First, read the sections on solar gains and over-heating in this booklet.



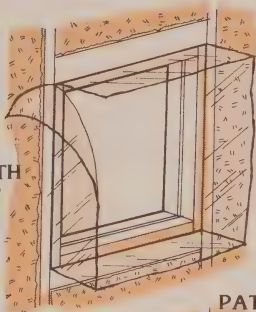
Installing New Windows

If you have removed an original window, you may have to do some preparation before installing a new one. In some cases, you will have to alter the size of the opening to accommodate it. If you are increasing the size of your window, you may also have to install a new lintel (load supporting beam) above the opening. Check this detail with your building inspector or other professional.

Once the opening has been adequately prepared, follow the sequence outlined below:

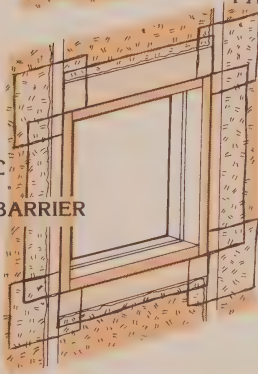
- Fill the space between the house frame and the new window frame with closed cell polyurethane strips or spray-in foam.
- If you are renovating the wall at the same time and installing a new air-vapour barrier, seal the air-vapour barrier to the new window. Attach a strip of plastic to the window frame over a bead of acoustical caulking. Extend the plastic from the window back to the air-vapour barrier on the wall, overlapping and sealing the joint over a solid part of the wall frame.
- Patch the siding on the outside and install trim on the inside. In some cases you will need new trim.

**NEW WINDOW
INSTALLED WITH
PLASTIC STRIP**



PATCH CORNERS

**SEAL PLASTIC
STRIP TO
AIR-VAPOUR BARRIER**



Movable Insulation

Another effective means of increasing comfort and reducing heat loss is to install movable insulation over your windows.

In most cases, you will want the light and view provided by windows and will prefer to use movable insulation at night. However, if you have windows that don't get much sun and are not in use (e.g. in the basement, unused rooms, etc.) you can install a unit for the entire heating season.

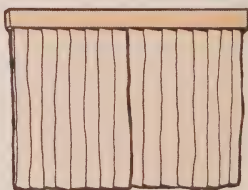
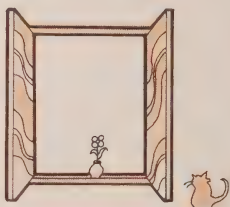
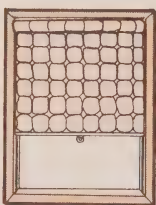
Adding RSI 1.2 (R-7), well-sealed, movable insulation to the average-size, double-glazed window at night should save the equivalent of between 30 and 40 litres of fuel oil annually.

Types Of Window Insulation Systems

Movable insulation systems vary widely in appearance, mode of operation and cost. Owner-built systems range from simple low-cost devices to extremely complex and expensive units. Similarly, commercial systems range from relatively low-cost kits to expensive automated systems.

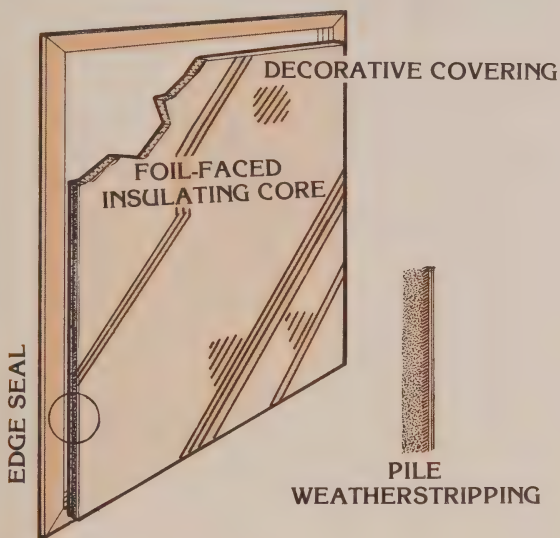
Common window insulation systems include shutters, shades and curtains.

- Insulating shutters range from simple pop-ins to units which are hinged at the sides or top. Most shutters are made with a rigid insulating board sandwiched inside a wood frame. High insulation values such as RSI 1.7 (R-10) can be easily incorporated.
- Insulated shades are stored above the window when not in use. Most shades are operated from a roller mechanism, but several do-it-yourself versions have folding sections.
- With insulating curtains you should provide a tight edge seal and still let the curtain fall naturally.



Design Criteria

- The insulating unit should have a good edge seal to prevent air circulation which can cause build-up of condensation or frost.
- The insulating shade or shutter should be attractive in both an open and closed position. You can cover the shade or shutter with decorative fabric or with a poster or picture to match the decor of a given room.
- The unit should be operated and stored easily. You can hang fixed insulating shutters on walls close to the window. Shades can roll up above the window.
- The insulating value should be as high as practical.
- The unit should contain a layer of material which prevents water vapour from passing directly through and condensing on the window (i.e. polyethylene, aluminum foil, etc.).



Inside vs Outside

You can place movable insulation systems either on the inside or outside of the window. Inside insulation must have a tight edge seal and a place for daytime storage. Outside insulation must be more durable to prevent freezing or deterioration. Outside units are also more difficult to operate.

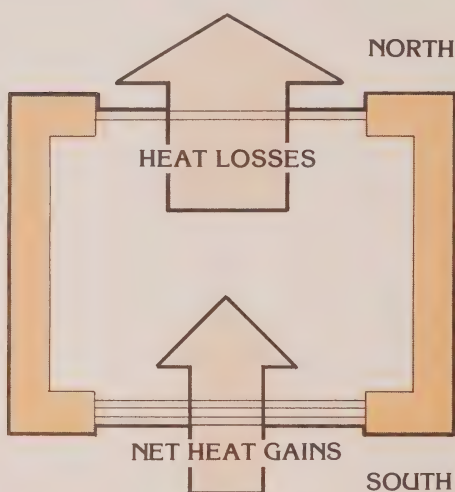
You should avoid using interior shutters during the day on sunny windows. There is a possibility that the extreme temperature differences can break the glass.

Solar Gains

While windows are a major source of heat loss in the home, they can also provide a net heat gain if they are properly located. You can reduce your heating requirements substantially by allowing sunlight to enter the house through south-facing windows. Even if your windows face south east or south west, they can provide heat. To do this, they should have unobstructed exposure to the sun and they should be either double or triple-glazed.

In the Toronto area, for example, it is possible to save the equivalent of 100 litres of oil each year by replacing an average north-facing, single-glazed window with a south-facing, double-glazed window. Major renovation provides the opportunity to relocate windows throughout the house to take advantage of the sun's heat.

You can ensure that the available solar gains are maximized in winter. Simply open curtains and blinds on sunny days and minimize obstructions on the outside that could block the sun.



Overheating

Twenty to 40 per cent of the heating needs of a well-insulated house can be met by properly sized and located windows. However, you can have too much of a good thing; overheating of some homes on sunny days is a common occurrence even during the winter.

If you have the opportunity to add south-facing windows, be cautious, especially if your house is well insulated. If areas of your house are prone to excessive heating, you can make them more comfortable through one or more of the following solutions.

Sun Shading

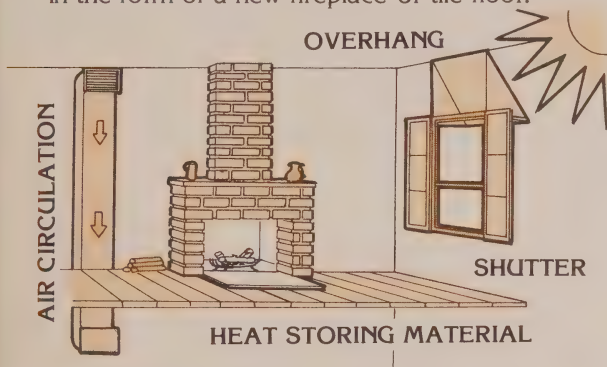
Shading techniques are a traditional way of reducing overheating. Remember that the sun is much lower in the sky in the winter. Below are some shading techniques:

- Install overhangs or awnings above windows to block the higher summer sun. Overhangs are not effective against the lower afternoon sun from the west.
- Plant deciduous trees which, when located in front of windows, provide shade.
- Use shutters or curtains as shading devices during the summer days.

Heat Storage

Heat can be stored in the building components of a home. Darker, heavy materials work best in direct sunlight to absorb heat during the day and release it to the living area at night. However, many homes do not have adequate heat storage (thermal mass) to prevent temperature fluctuations:

- Install additional drywall over existing walls to increase the heat storage mass.
- Add masonry materials (bricks, stone, concrete) in the form of a new fireplace or tile floor.



Air Circulation

When excess heat accumulates in one area of the house, you can circulate the air to another area. In this way you can eliminate the need for exhausting unwanted heat by opening a window or door.

- A return air duct located in the high, warm part of the house can draw air to the basement and throughout the house. Make sure it vents outside in the summer.
- Some furnace fans can run continuously at low speed so that house air is constantly circulated.

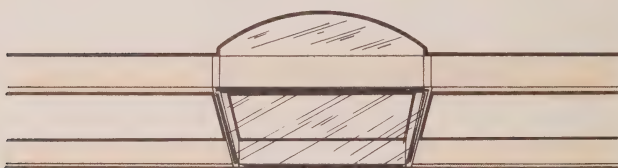
Skylights

Skylights can allow direct sunshine into areas of the home that don't have windows (e.g. attics, hallways, stairwells, etc.) and provide both warmth and light. If they are properly located, skylights which open cool the building during the warmer months by allowing warm air to escape through the roof.

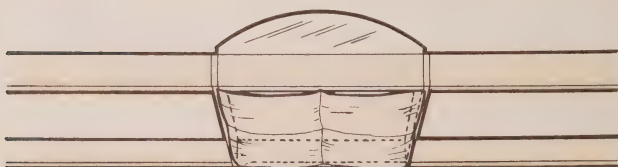
On the other hand, poorly planned skylights can cause overheating in the warm months and lead to unnecessary heat loss in winter.

Bear these points in mind when planning the installation of a skylight:

- Avoid skylights in horizontal locations — they invariably lead to overheating in summer. If a skylight must be installed in a flat roof, consider building a south or east - facing tilted frame for it.
- To reduce overheating during the summer, equip the skylight with a blind or gauze or other shading device. In winter, install movable insulation at night to cut down on heat losses.
- An opening skylight can permit the escape of warm air during the summer. Some models are equipped with automatic opening devices that can be used in inaccessible areas.
- Install double or triple-glazed skylights.
- To increase the amount of light entering the living area of the home, paint the area of wall or ceiling adjacent to the skylight a light colour.
- When installing a skylight, make sure you flash and waterproof the opening properly.



INTERIOR STORM IN WINTER



REFLECTING GAUZE IN SUMMER

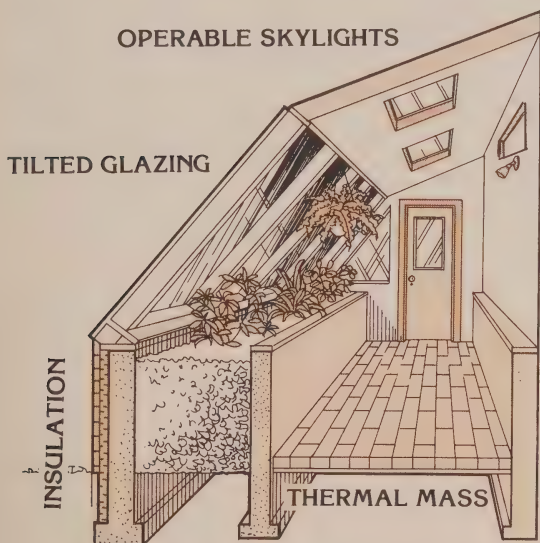
Solaria and Greenhouses

Many homeowners consider adding a sun space to their home for growing plants, for use as a breakfast nook or simply for additional living area.

A well-designed solar addition can provide a net heat gain to the home over the heating season and can actually reduce your fuel bill. On the other hand, if it is improperly designed and operated, it can cause overheating in summer and can lead to an extra burden on your fuel bill in winter.

To design a solarium or greenhouse properly:

- Situate the structure so that it maximizes the solar gains in the winter. Within 30° of due south is best.
- Tilt the glass at an angle between 50° and 90° up from the horizon.
- Add high levels of insulation in the walls and ceiling and use air-tight construction techniques.
- Make provision for adequate thermal mass which absorbs the extra heating during the day and releases it at night.
- Allow heated air to circulate to the main body of the house. This could mean locating fans in the adjoining wall of the house or adding vents to allow natural convection.
- Ventilate to the outside to allow heated air to escape in the warmer months. Vents or opening skylights should be located at the peak, with doors or vents to allow cooler air into the structure.



Getting the Job Done

Whether you are buying replacement windows, sheets of glass, movable insulation or caulking and weatherstripping, you can save money by shopping around. Spend time on the telephone comparing prices for different products. Make sure you buy the most energy-efficient type within your price range.

You should be able to save money by purchasing odd-sized units and altering the window opening, or by finding units with slight flaws or scratches.

Contracted vs Do-It-Yourself

If you are contracting the work, obtain estimates from at least three reliable contractors. Make sure that each bid you receive specifies the work entailed, time required, cost and payment schedule:

- Specify to the contractors that you want an energy-efficient job. Discuss with them the options outlined in this booklet.
- Consider doing some of the preparatory work yourself. The easier the job looks, the lower the bids will be.
- If possible, look at the contractor's past work or talk to previous customers.

Doing the work yourself can result in savings of up to 50 per cent on a job. By paying only for materials and tool rental, and by adequate pre-planning, a competent do-it-yourselfer can perform an adequate job. However, some of the work outlined in the booklet demands some fundamental carpentry skills. Before enlarging or adding new openings to your wall, you should get the advice of a qualified professional and you may also require a building permit. If this is your first major home renovation, read some do-it-yourself books and familiarize yourself with the kinds of tools and techniques commonly used for this kind of work.



Access

Literature

Movable Insulation: William Langdon, Rodale Press, 1980.

An excellent book analysing window heat losses and detailing the use of various insulating devices for reducing night time losses.

Thermal Shades and Shutters: William Shurcliff, Brick House Publishing, 1980.

This book investigates the subject of windows and window insulation systems, detailing hundreds of commercial and do-it-yourself approaches.

The Super-Insulated Retrofit Book: Argue and Marshall, Renewable Energy in Canada, 1981.

This book outlines the various components of the total retrofit of existing houses, including adding glass to the existing window sash.

The Solarium Workbook: National Research Council, Solar Technical Series #2, 1981.

This publication provides criteria and worksheets for the design and construction of solaria and solar greenhouses.

Information From The Ministry Of Municipal Affairs and Housing

Booklets

First, Seal Your House

Conserve Energy When You Renovate

Make The Most Of Your Heating System

Fact Sheets

Fresh Air and Humidity in a Tighter House

Energy Checklist for Renovators

Improving Fireplace Efficiency

Caulking and Weatherstripping

Basement Insulation

Air-Vapour Barriers

Exterior Insulation

Flat Roofs and Cathedral Ceilings

For Further Information

Renovation and Energy Conservation Unit
Ministry of Municipal Affairs and Housing
Queen's Park,
Toronto M7A 1N3
416-965-4073

Government Programs

There are a number of government assistance programs available to qualified homeowners. Contact the Ministry of Municipal Affairs and Housing or the appropriate organization for specific information.

OHRP *Ontario Home Renewal Program*

If your family income is \$15,500 or less after allowable deductions, you may qualify for Ontario government funding under OHRP to repair your home to local standards. A similar program, Residential Rehabilitation Assistance Program is administered by CMHC.

REAP *Residential Energy Advisory Program*

Sponsored by Ontario Hydro, this program offers loans to upgrade the energy efficiency of your home at Ontario Hydro's borrowing rate. The program is offered in Hydro's rural service area. Many local electrical utilities are expected to introduce a similar program — many already offer energy conservation advice. Call yours and ask.

CHIP *Canadian Home Insulation Plan (CHIP) Program Update*

Energy, Mines and Resources Canada has announced a revision to the Canadian Home Insulation Plan (CHIP). Effective November 15, 1982, the maximum taxable grant of up to \$500 will be calculated on 60 per cent of the combined costs of materials and labour. Minimum attic insulation levels of R34 have been set for grant eligibility. Homes built before 1971 qualify. Many homeowners use this grant to insulate their attics, but it can also be used for weatherization, and movable insulation.

People who live in area codes 416, 519, 613 and 705 can call toll free 1-800-268-1818.

Those Ontario residents living in area code 807 can call collect to 1-416-789-0581.

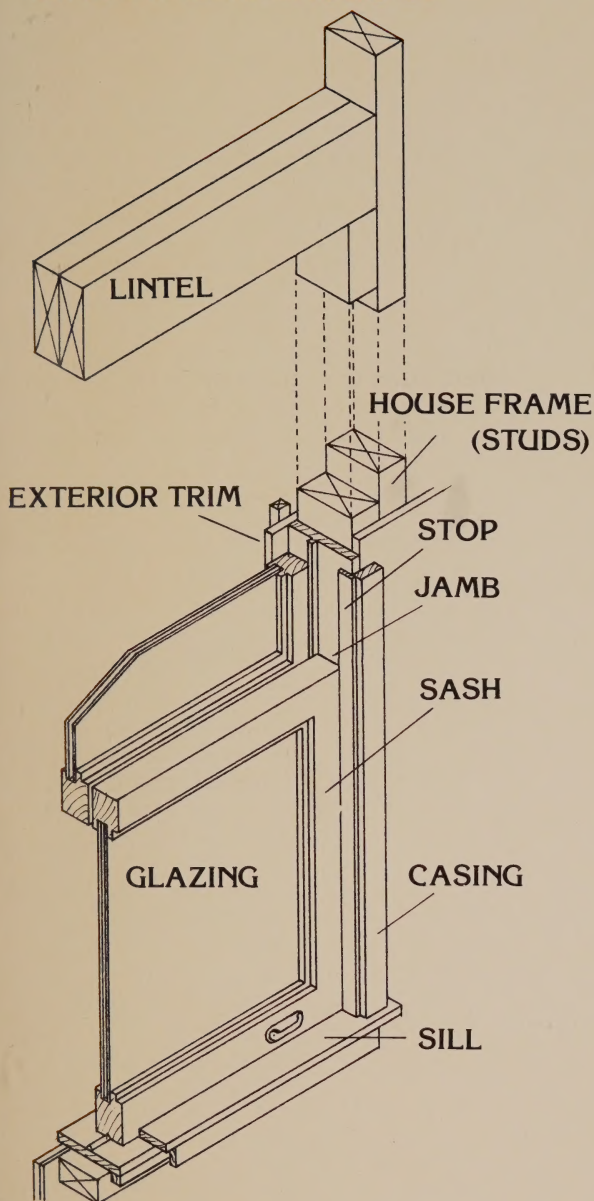
Enersave Heatline

A toll free line to answer your questions on insulation, weatherization, furnace maintenance and federal programs and literature:

1-800-267-9563 (toll free)

995-1801 (in Ottawa)

WINDOW TERMINOLOGY



This booklet has been prepared by Renewable Energy in Canada on behalf of the Ministry of Municipal Affairs and Housing.



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